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VI. *Observations upon the Effects of Electricity applied to a Tetanus, or Muscular Rigidity, of four Months Continuance. In a Letter to the Royal Society. By William Watson, M. D. F. R. S. Member of the Royal Colleges of Physicians of London and Madrid, and Physician to the Foundling Hospital.*

To the Royal Society.

Gentlemen,

Read Feb. 10, 1763. **E**VER since your establishment, the communicating the history of uncommon diseases has seldom failed of a favourable reception by you, and has been frequently thought to merit a place in your journals and register-books. This has emboldened me to lay before you the following history.

CATHERINE FIELD, a girl in the Foundling Hospital, aged about seven Years, and otherwise a healthy child, having been disordered a few days with what were considered as complaints arising from worms, was observed, on Thursday, July 8, 1762, to open her mouth with great difficulty. This particular circumstance increased so much, that by the Sunday following, when I first saw her, her teeth were so much confined, it was with difficulty that even liquids could be admitted into her mouth. She had two days before parted with two worms, and had
several

several very offensive stools. Her breath was now, and had been for some days, very fetid.

Though her jaw was locked very close, she was without pain; even in the Temporal and Masseter muscles, whose office is to bring the under-jaw to the upper; and which, in this instance, were tense, hard, and spasmodically affected. She was feverish, her pulse was quick, and her flesh hot; and she had had but very little sleep.

On Monday, July 12, I visited this poor girl in consultation with my learned and ingenious friend and colleague Dr. Morton. We found she had had a restless night; her fever was high, and it was infinitely difficult to introduce any thing between her teeth. As there had been no wound, no eruption repelled, we were of opinion, from her offensive breath and other indications, that the spasm of her jaw was symptomatic, either of worms or foul bowels.

Whatever was admitted into her mouth was swallowed without difficulty; neither in this state of the disease was her breathing at all affected. The regimen we put this patient under, for this formidable complaint, will be mentioned hereafter.

For near three weeks the disorder confined itself to the jaw, during which time she was constantly feverish. At times indeed her fever ran very high, and her pulse beat 130 strokes in a minute. At other times it beat only about 100; but never for these three weeks was it slower than that number.

Notwithstanding our best endeavours, the disease not only continued, but the rigidity communicated itself to the muscles of her neck, so that she could not

move her head in the least: And from pains shooting down her back, we had reason to apprehend, and which indeed did soon after happen, that the muscles of her back would soon likewise be rigid.

After the back was affected, the disease extended itself very fast; so that by the end of September, almost all the muscles of her body were rigid and motionless. To be somewhat more particular; the rigidity from the Temporal and Masseter muscles had extended itself to the cheeks, to the neck, breast, abdominal muscles, all those of the back, the right arm, the hips, thighs, legs, and feet. Nor were they by any force, that could be exerted with safety, to be extended. By the rigidity and contraction of the large and long muscles of the back, the Os Sacrum and hips were pulled towards the shoulders; so that the spine formed a very considerable arch. By the superior strength of the Flexor muscles of the thighs to that of the Extensors, the legs were pulled up almost to the thighs.

Of all her limbs, the left arm only preserved any motion. Of this the joint of the shoulder was rigid, that of the elbow extremely impaired; but the wrist, hand, and fingers, were reasonably pliant. The various muscles subservient to the motions of the eyes, eyelids, lips, and tongue; as well as those, internal ones at least, which assist in performing the offices of respiration and deglutition, did not seem in the least to partake of the rigidity.

From the end of September to the middle of November, the disease, as though it had exerted all its power, was at a stand. The feverish heat had left her, and her pulse beat generally between eighty
and

and ninety strokes in a minute. But during this interval the poor patient was seized many times, both in the night and in the day, with violent convulsions in those muscles of the eyes, face, and right arm, which had any mobility left. These were so severe, that, in her weak and wretched state, her attendants imagined every attack would put an end to her distresses.

In this state, partly from the severity of the disease and partly from the very small quantity of food which could be given to her, and which was only through a small opening made by extracting two of her teeth and without which she must inevitably have been starved, she was emaciated in a most extraordinary manner. Her belly was contracted, and pulled inwards towards the spine. Her whole body, to the touch, felt hard and dry, and much more like that of a dead animal than a living one. This, added to the very great distortion of her back and lower limbs, heightened the disagreeable spectacle, and called to my mind that admirable passage of * Aretæus, who, when treating of and contemplating this disease, calls it "*inhumana calamitas, injucundus aspectus, triste intuenti spectaculum, et malum insanabile.*" And he subjoins, that "their distortions are such, that they cannot be known by their most intimate friends;" which in the case before us was most strictly true.

During the continuance of this disorder, which had lasted now more than four months, nothing had been omitted that either Dr. Morton or myself

* Cap. vi. Ἐξάνθρωπος ἡ συμφορὴ, καὶ ἀπερπῆς μὲν ἡ ὄψις, ὀδυνηρὴ δὲ καὶ τῷ ὀρέοντι θέν, ἀνίκεστον δὲ τὸ δεινόν.

could suggest for her relief. While worms or foul bowels could be suspected to have occasioned this illness, as her stools were at first very offensive, and she had voided two worms, vermifuges of the most celebrated kind, linseed oil both by the mouth and by clysters, and such other medicines as tend both to carry off or destroy the worms, and cleanse the bowels, were assiduously administered. But no relief arising from these, bleeding with leaches at the temples, when her fever ran high, blisters behind the ears, round the neck, upon the head, and in various parts of her body, were from time to time applied, as the disorder seemed to indicate. Nor during this time were antispasmodic remedies of various kinds omitted, and that in very liberal doses. Among these, as in several cases of locked jaws, related by authors of undoubted credit, opiates had been found to have been attended with great success, *Tinctura Thebaica* was copiously given. So that, between the 12th of July and the end of the month, more than nine hundred drops of that tincture were taken: A large quantity for so young a person! This we sometimes thought had a good effect, as the jaw was at times somewhat loosened; but this advantage was temporary, and the stricture soon returned as severe as before.

Though this medicine, given in large doses, did not affect her head, but only gave her quiet nights, yet it was occasionally obliged to be suspended; as her pulse was at times much sunk, and her sweats cold and clammy. Volatile liniments were liberally used to the rigid parts, and warm bathing was continued for many weeks, with much friction, while in the warm water.

After warm bathing had been so long tried without sensibly good effect, cold bathing, recommended by Hippocrates * for the cure of this disease, was directed; and she was dipped several times, without being apparently the better or worse for it.

From the end of September, as what had been done hitherto had not been able to prevent the rigidity extending itself, we desisted from attempting to relieve her by medicine, and determined to nourish and support her; and wait to observe, though it was scarce to be expected, whether nature unassisted would point out any crisis for her relief. This attention was continued to the middle of November, without any other alteration than that her convulsions increased in their force; and every day, by those who were about her, was expected to be the last; and which was an event, as the prospect was so unpromising, much to be wished for. Dreadful however as her situation was, she was still alive: we were desirous therefore of omitting nothing, that in the least might be expected to relieve her.

I HAD heretofore many times observed, that in paralytic limbs, the muscles of which had for a considerable time ceased to be subservient to the will of the patient, I had been able, by the means of electricity, to make any muscle I thought proper contract itself, and act as a muscle, without the patient's being able to controul it. I had seen in one instance the good effects of electricity, in restoring to the hands and arms of a paralytic almost their accustomed strength, and voluntary motion; but these good effects, the

* Περὶ νοῦσων, Lib. III.

greatest part of them at least, were only temporary, and the patient relapsed. But I had never seen or known the effects of electricity in the contrary affection, viz. rigidity of muscles. I was very desirous therefore of trying its effects in this instance, and of shaking the rigid muscles by electricity; especially as I could have it done with very little pain, and no danger to the patient.

I just now mentioned, that I was able in paralytic persons to make any particular muscle at my will exert its action. This was to be effected by *simple electrifying* only; but by modifying and altering the apparatus of the *charged vial*, I was able to do much more. It is now seventeen years since, that I discovered, and communicated it to you at that time, that by means of the *electric circuit* I could cause the electricity to pervade any muscle, any number of muscles, or whatever part of the body I pleased, without affecting the rest with that unpleasant sensation. Many experiments, relating to this matter, and which I laid before you, were printed in the forty-fourth volume of the Philosophical Transactions.*

But to return to our patient: We ordered her to be electrified about the middle of November. This was done every day, or every other day for about twenty minutes, by *simply electrifying* the muscles subservient to the motion of the lower jaw, her neck, and her arms. This at first was very difficult to be achieved; as she was not capable of being placed in a chair to be electrified by herself, and as an assistant could scarce hold her on account of her being greatly distorted. It with difficulty, however, was done.

* Pag. 718, & seq.

After about a fortnight, the convulsions left her, and her sleeps were longer and more quiet; but the rigidity continued the same. After this, such parts of her body, as were thought expedient, were made part of the *electric circuit*, and were shook by the explosion of the *charged vial*. These applications were at first more particularly made to the Temporal and Masseter muscles (the parts first affected) and to the muscles of the neck and arms; afterwards to those of her back, hips, thighs, and legs. Care was taken to moderate the shocks in a manner, not to be too severe; and she was electrified every second, and sometimes every third day.

The fits, as I just now mentioned, and which were of the epileptic kind, left her in about a fortnight from her being electrified, and have never since returned, even in the slightest degree. In about a fortnight more her jaw was looser, and the muscles of her neck and arms had a large share of motion: and it was very observable, that as her muscles increased in their power of motion, they increased in their size, and the patient in her strength. By the end of January, not to be too tedious in my narration, by continuing the electricity, every muscle in her body was loose, and subservient to her will; and she could not only stand upright, but walk, and can even run like other children of her age. With her strength, she has so far recovered her flesh and colour, that her present appearance is that of a reasonably healthy child; and her breath has quite lost its late offensive smell. The only parts of her body not quite so loose as the rest, are the Temporal and Masseter muscles, which were the parts first affected by the disease.

This prevents her opening her mouth quite so wide as she formerly could; but this hindrance is so little as not at present to be taken notice of, unless hinted at beforehand. She now goes to school, lives at large, and goes out every day when the weather is seasonable; but the electrifying is still continued, tho' not so constantly and regularly as before. This I propose should be continued, until the return of warm weather. In the last week this child was presented to the committee of the Foundling Hospital, where several of the governors, who were apprised of her case, expressed their amazement at her, so unexpected, recovery.

It is here to be observed, that, except the muscles subservient to the motion of her jaw, none so long continued their rigidity as those of the back, denominated "*longissimi dorsi*" by anatomists. These, when almost all the other muscles of the body were loose, remaining tense and hard; and, by pulling the loins up towards the shoulders, continued the arch of the spine before mentioned. As the patient was so much emaciated, these muscles might be traced, on each side of the spine, from their origin to their insertion; and for a considerable time after she was in other respects recovering, these felt hard like twisted cords. At length, however, by directing the electricity through them, and the parts near them, in a very liberal quantity, these likewise gave way, and are now as loose as any other muscles of her body.

In proportion as a matter is extraordinary, the proofs to support its reality should be extraordinary. That excellent maxim, "*Nil temere credere*," should
never

never be lost sight of in our inquiries ; otherwise novelty and the love of the marvellous will be apt to mislead us. On the other hand, the indulgence of an extravagant Pyrrhonism may prove equally detrimental in every endeavour to extend the bounds of science. It may prevent the giving due weight to matters of real information, and hinder their being made useful. For my own part, I should think it an indignity offered to the Royal Society, to lay before you any extraordinary phenomenon, which is supported only by a slight degree of evidence. On the contrary, when a number of concurrent circumstances tend to establish a fact, we ought not in a certain degree to refuse our assent to it, though somewhat out of the common course. Thus in the case before us ; when an unusual disease of several months continuance, and when the patient was supposed to be reduced to the last extremity ; when medicines and applications of every kind, celebrated by the ablest writers and practitioners both antient and modern, had been tried with little or no effect, at least with regard to the rigidity ; when during a course of electrifying no medicines or applications of any kind were made use of ; when likewise, during this course, the patient voided no worms, had no purgings, eruptions on the skin, or kindly impostumations, which might have been considered as critical discharges, and to have brought about the cure ; when, I say, none of these things happened, and the patient under electrifying only, and that at a very severe season of the year, has been restored to perfect health, I cannot refuse my assent in believing it effected by the power of electricity. That so active

a principle, when properly directed to the diseased parts, should have important effects, no one can doubt who has been in the least conversant with it. Though at the same time I confess, well apprised of the salutary effects of warm weather in restoring a more perfect motion to torpid limbs, that had the electrifying been begun in March, and continued to the end of May, though attended with the same success as in the present instance, I could not have suppressed my doubts of the warm weather greatly contributing thereto. But as this was done during the depth of winter, and that a severely cold one, no scruples, in my mind at least, can arise upon this head. I take the liberty however to lay the whole evidence before you, that every one may make from it such deductions as he thinks proper.

Perhaps indeed some may be of opinion, that even the cold weather contributed to cure this disorder. But it is well known, that warmth relaxes the animal fibres, and that cold constipates and braces them. In the case before us, the muscles, composed of minute fibres, were as rigid and tense as they well could be, even in a diseased and obstructed state. If cold therefore contributed any thing, it was to make this case worse. And this is conformable to the opinion of Aretæus*, who, among the causes of the disease, reckons intense cold; and says, “that for this reason the winter of all the seasons is most productive of this disease.” He subjoins, “that women are more subject thereto than men, on account of the coldness of their constitution.” Celsus † like-

* Aretæus, Lib. I. Cap. vi.

† Celsus, Lib. II. Cap. i. Frigus modo nervorum distentionem, modo rigorem infert: illud *Σπασμὸς*, hoc *Τέννωσις* Græcè nominatur.
wise

wife expressly asserts, that cold sometimes is the cause of it, and in another part of his excellent work says, “ that the greatest caution should be used to defend the patient from cold; and that therefore the fire in his room should be constant.” He moreover recommends warm bathing both in water and oil, as conducive to the cure of the disease. To these may be added the sentiments of Cælius † Aurelianus, who considers that cold is frequently the cause of this disease. He recommends various kinds of warm external applications; such as warm bathing, rubbing the affected parts with warm oil, the application of warm cataplasms, bags of heated bran, or linseed. With Celsus, this author recommends, that attention be given to the warmth of the patient’s chamber. How far therefore, for the reasons and authorities before-mentioned, cold weather could probably assist in the cure of the case before us, need not in my opinion be insisted upon.

AND now, Gentlemen, permit me to make a few observations upon the disease itself, which, at least in the degree of the case before you, is a very rare one in temperate climates. In warmer countries, and especially between the tropics, it is too often seen. It was well known to the ancients. Hippocrates § calls it *Τέτανος*, and says, that those who have it severely, die on the fourth day; if they survive that day, they recover. He makes farther mention of it in other parts of his works*; more particularly in his book *Περὶ Νούσων*, where he describes both the

† De Morbis Acutis, Lib. III. Cap. vi. viii.

§ Aphorism, Lib. V. Sect. vi.

* Vide Lib. *Περὶ κρείσμων*—*Περὶ τῶν ἐνδὸς παθῶν*, & alibi.

Tetanos and *Opisthotonos*. In this part of his work, instead of the fourth, he mentions once, and repeats it, that if they live beyond the fourteenth day, they recover. Lest it should appear, that the father of the medical art seems to contradict himself, it may not be improper to remark, that when he says, that the *Tetanos* is mortal in a very few days, he most generally means those which are symptomatic, and are attendant upon wounds, luxations, and bruises; such as the three instances mentioned in his *Epidemics*. Those affected with this disease, mentioned by Hippocrates in his book *Περὶ Κελεύσεων*, are expressly said to arise from wounds. These were soon mortal. But where these diseases took their rise from other causes; they were less violent, continued longer, and the expectation of recovery was greater. In his book therefore, *Περὶ τῶν ἐν τῷ πνεύματι*, when treating of the *Opisthotonos*, attendant upon a fever, inflammation of the throat, or other internal disorders, he says, that if they live beyond the fortieth day, they recover.

Aretæus*, under the same appellation with Hippocrates, has given us an excellent history and remarks upon this disease, as well as upon the *Opisthotonos*, and *Emprosthotonos*, which are nearly related to it; or, to speak more properly, the same disease affecting different muscles, and throwing the body into different kinds of distortion. Celsus† has mentioned and described this disease, to which no name was assigned by his countrymen, and has called it “*Quidam nervorum rigor*.” Tho’ this excellent author reckons it among the diseases of the neck, the parts

* *Morb. Acut. Lib. I. Cap. vi.*

† *Lib. IV. Cap. iii.*

first affected by it are the muscles subservient to the motions of the lower jaw, from which it is usually, if the disease continues, propagated to those of the neck. Cælius * Aurelianus has, as it is supposed from Soranus, described it, and handed down to us such methods of cure, as had been found in his time most successful.

Pliny § mentions the Tetanus in many parts of his Natural History. He forbids the use of wine to those who labour either under this disease, or the Opisthotonus. He recommends in different parts of his work, as internal remedies, castor, hellebore ||, the ashes of the fig-tree, pediculi marini, and pepper. He advises warm baths, with the nitre *of the ancients* dissolved in them; and directs the patient at other times to be rubbed with the coagulum found in the stomach of a calf, or with the juice of Peucedanum, or hogs-fennel. This, it is to be presumed, was the most general method of treating these diseases, in the age wherein this author wrote.

This disease is frequent in Greece, Italy, and in the warmer parts of Europe, where its effects are severely felt. † Bontius, who resided long in the East Indies, has briefly described it; which, though he says it is

* Morb. Acut. Lib. III. Cap. vi.

§ Plinii Hist. Nat. Lib. XXVI. XXXI. XXXII.

|| Ibid. Lib. XXV. The hellebore made use of, was to be prepared in (at that time) a newly discovered manner, which was to prevent the effects of its acrimony. This was, by putting the hellebore between radishes split, and then tied together, including the hellebore; which, by being macerated in this manner for about seven hours, was supposed to become more mild in its operation.

† Bontii Meth. Medendi, Cap. ii. De Spasmo.

rare in Holland, may be reckoned endemic in India. He seems not to have known what had been written by his predecessors upon this subject. He takes notice, that sometimes men seized with it became *dicto citius* rigid as statues.

An admirable account of this disease was a few years since communicated to the public by Dr. Lionel Chalmers † of South Carolina, where it is very frequent, especially among the negroes. And I am informed by a learned gentleman of undoubted credit, that in our military operations between the tropics in America, great numbers of our people, particularly of those who were wounded, died with locked jaws.

In England we generally to this disease give the name of the *locked jaw*; but that, let it arise from what cause it may, is only one symptom of it. If it continues, as in the case before you, the occasion of this paper, it propagates its rigidity to the neck, breast, and then to the other parts of the body.

It is seldom seen here that the Tetanus is an original disease. It is generally symptomatic, and the consequence of some other disorder. It frequently is subsequent to wounds and bruises of the nerves and tendons. I have known it arise to a certain degree from the sudden checking of an eruption upon the skin. I knew a temporary Opisthotonus occasioned by the too sudden loss of a large quantity of blood. To these permit me to add, that the Tetanus of the Temporal and Masseter muscles constantly attended those whom I have known to have been accidentally

† Medical Observations, Vol. I. pag. 87.

poisoned by taking the *Oenanthe aquatica succo viroso crocante* of Lobel; and of which, two communications of mine occur in the Philosophical Transactions.

I must here remark, that in the true Tetanus, the arms, when rigid, are straight, and extended along the trunk; the legs and thighs are likewise straight; but the case before you, in some degree, partook of the Opisthotonus, especially in the lower parts; as the spine was remarkably curved, and as the legs were pulled up towards the thighs.

The Tetanus I now lay before you, was an original disease; as there had been no wound, no eruption suppressed, nor other cause, which, we imagined, could occasion it. A case of a similar kind, as an original disease, occurs in Dr.* Storck's *Biennium Medicum*. And the Emprosthotonus, mentioned by the ingenious Dr. Macaulay, in the second volume of the Medical Observations, lately published, seems to have been likewise an original disease, and not a symptom of any other. As the case I now communicate is a very singular one, at least in Great Britain, and the treatment of it not less singular, though attended with all possible success, I had reason to hope that you would not be displeased to have it laid before you, in a manner somewhat circumstantial. I am firmly of opinion, if the epilepsy had left this patient, and life had continued, that she would have remained a most miserably helpless object, and as confirmed a cripple as can be imagined.

At present the patient is well; but if, contrary to

* Part I. Pag. 6.

expectation, she should relapse, or any thing should occur in her case worthy your notice, I shall not fail to acquaint you with it; and am, with the utmost regard,

Gentlemen,

Your most obedient humble Servant,

William Watson.

Lincoln's Inn Fields, 9 Feb. 1763.

P. S. The patient continues well, her jaw is as loose as ever. The electrifying has been discontinued above a month; and she is in every respect perfectly recovered.

27 March 1763.

July 8, 1763.

The patient is perfectly well, and there remain not the least indications of her having been diseased.

W. W.